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OFFICE OF
PREVENTION, PESTICIDES AND
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MEMORANDUM

SUBJECT: Experimental Use Permit for Imidacloprid Products NUPRID 2F and MALLET 0.5G for Control of Burrowing Shrimp on Oyster Beds in Washington State.

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TO: Joanne Edwards, Risk Manager Reviewer
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EFED has conducted a review of the proposed new uses for Imidacloprid. The assessment and conclusions are as follows:

Background

Washington State University (WSU) is applying for an EUP (Experimental Use Permit) for NUPRID 2F and MALLET 0.5G to control borrowing shrimp on oyster beds. The EUP is to be used to investigate the efficacy and non-target effects of Imidacloprid against burrowing shrimp in Willapa Bay and Grays Harbor in the State of Washington. The new products are for aquatic treatment only. The proposed use period is May through October 2010. NUPRID 2F (21.4% ai) is to be applied to 80 acres. MALLET 0.5G (0.5% ai) is to be applied to 30 acres. The highest current application rate for crops is 0.5 lbs ai/A. Under the current EUP, 1-2 lbs ai/A is proposed to be used on some of the acreage to be treated. All aerial and ground based applications must be made to exposed beds at low tide. Subsurface injections from a floating platform must be made to beds under water. A 200 ft buffer zone must be maintained for aerial applications and a 50 ft buffer zone must be maintained for hand held applications. All EUP restrictions should be followed. All spray drift management precautions and restrictions should also be

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followed.

Conclusions
EFED's screening assessment suggests that exposure from this compound to an estuarine/marine system supports the intent of this EUP. Acute and chronic risk is demonstrated to estuarine/marine invertebrates (burrowing shrimp) in the sediment pore water (acute RQ = 5.20; chronic RQ = 19.50). This demonstrates efficacy of Imidacloprid to the borrowing shrimp. This assessment also demonstrates very low risk to the surrogate eastern oyster species (acute RQ < 0.0013). Risks within the Bay will likely be localized to the target area. Imidocloprid is shown to be less toxic to estuarine mollusks than it is to estuarine invertebrates by several orders of magnitude.

Environmental Fate of Imidacloprid
A summary of key environmental fate parameters (as determined for aquatic exposure modeling) is provided in Table 1. The major routes of dissipation for imidacloprid appear to be photolysis and anaerobic aquatic metabolism. Imidacloprid appears to be stable to aerobic soil metabolism. The chemical is mobile and is a major concern for ground waters, where there have been detections. Its transformation product imidacloprid guanidine is of concern as well. Imidacloprid may readily runoff dissolved in water and reach adjacent bodies of water. Since the chemical appears to be persistent under aerobic soil metabolism, imidacloprid may be available for runoff for periods exceeding one season. Potentially important environmental degradates include:

1) imidacloprid guanidine, 1-[(6-chloro-3-pyridinyl)methyl]-2-imidazolidinimine {Alias NTN 38014, NTN 33823}
2) imidacloprid olefin, 1-[(6-chloro-3-pyridin1yl)methyl]-1,3-dihydro-2H-imidazol-2-imine
3) imidacloprid urea, 1-[(6-chloro-3-pyridinyl)methyl]-2-imidazolidinone.{NTN 33519}.

It appears that photolysis plays an important role in the dissipation of imidacloprid, both in aqueous solution (half-life 0.2 days) and on soil (half-life 39 days). Another route of transformation that appears to be important for imidacloprid is anaerobic aquatic metabolism (half-life 27 days), with the formation of imidacloprid guanidine (66% at 249 days; 1-[(6-chloro-3-pyridinyl)methyl]-2-imidazolidinimine {Alias NTN 38014, NTN 33823}), a compound that appeared to be very persistent. Imidacloprid is very persistent under aerobic soil metabolism conditions (half-lives were 660, 188, 248 and 341 days in four soils).

Based on its K_{OC} values, imidacloprid would have medium mobility, with K_{OC}s ranging from 161 to 256 (based on nine soils, five domestic and four foreign). However, based on its K_{ads} values, it appears that imidacloprid is mobile and has the potential to leach to subsurfaces. The K_{ads} range is 0.96-4.76 for the same nine soils. On the other hand, imidacloprid guanidine appears to be less mobile than the parent imidacloprid (K_{OC} range 327-942; K_{ads} range 0.76-14.20).

Due to the very low octanol/water partition coefficient of imidacloprid, it is not expected to bioaccumulate in fish and the data requirement was waived.

Five terrestrial field dissipation studies confirm the findings in the laboratory, that under aerobic soil metabolism conditions, imidacloprid persists substantially. The half-lives were as follows: >365, >>365, 146, 107, and >120 days.

Table 1. Imidacloprid environmental fate parameters (as used for aquatic exposure modeling input).

Parameter	Input	Source
Solubility (ppm)	580	Product chemistry submissions
Molecular weight	255.66	http://chemfinder.cambridgesoft.com and Product Chemistry submissions.
Vapor Pressure (mm Hg or torr), 20 C	1.5E-09	Product chemistry submissions; Miles Technical & Safety Information sheet, March, 1992.
Henry's Law Constant (atm m3 mol -1)	4.0E-12	Registrant. Unable to locate original submission. SRC PhysProp Database lists as 1.65E-15 atm-m3/mole at 25 C as an estimated value apparently calculated from the vapor pressure and water solubility.
Hydrolysis $t_{1/2}$ @ pH 7 (days)	Stable	MRID 42055337
Aerobic soil $t_{1/2}$ (days)	520	MRIDs 452393-01, 02, 42073501; 90% upper bound confidence limit of mean
Aerobic aquatic $t_{1/2}$ (days)	1040	2x the aerobic soil input value, per EFED guidance document
Photolysis $t_{1/2}$ in water (days)	0.2 to 39	Input guidance & MRIDs 42256376; 42256377; with consideration of persistence in irradiated water in ecotoxicity studies.
Organic carbon partition coefficient - K_{oc} (mL/g)	178	MRIDs 425208-01 and 420553-38
Partition coefficient – K_d (mL/g)	2.4	Willapa Bay Study

Exposure Assessment in Willapa Bay

OPP has evaluated exposure data from two studies of Imidacloprid use for control of burrowing shrimp in Willapa Bay. The first is by Felsot and Rupert (2002).

In this study, water and sediment were collected directly in the treated plots or at various distances along a westerly transect from the plots. To establish transects, the center of each plot was located and personnel walked to assigned distances in the direction of tidal flow by following the flow lines left in the sandy sediment at low tide. Water samples were collected as the tide was coming in, and sediment samples were collected during low tide after the sediment was exposed. For this study, imidacloprid dissipation was monitored as the tide was rising in Willapa Bay. Four weeks after application, additional water samples were collected directly above the treated plots.

Over 99% of applied material dissipated from small plots within 24 h, but residues near the analytical detection limit were found in sediments 28 days later. At a distance of 152 meters along a transect from the plot in the direction of tidal flow, imidacloprid residues in water peaked within 10 minutes after initiation of tidal flow. Within 30 minutes, Imidacloprid residues were not detected, nor were residues detected in the water any time over the next month after application.

Within 15 meters from the edge of treated plots, average imidacloprid residues peaked at 17.7 µg/L (0.017 mg/L) when the incoming water was 2 inches deep. At a distance of 152 meters from the treated plot, Imidacloprid was detected (average of 1.0 µg/L) about five minutes after tidal flow started but quickly dissipated to below detection levels as the tide continued to rise. Twenty-four hours later, Imidacloprid was not detected in water sampled directly over the plots, nor was any detected 28 days after application either above or outside of the plot (maximum distance monitored was 152 m).

Plots were treated for burrowing shrimp control and then residues were monitored in sediment for 28 days. Initial concentration after application was 0.461 mg/kg dry weight. The half-life was less than 1 day, and 28 days later residues were still detectable (0.005 mg/kg) in sediments over the treated area. Within one day, residues in treated plots dropped to 0.0164 mg/kg and were not detected after 28 days (limit of detection at 0.0025 mg/kg). Imidacloprid rapidly dissipates from water by aqueous photolysis (half-life of 0.2 days) but is stable to hydrolysis at pH 7.

Chronic dry weight sediment concentration values (21 and 60 averages) are calculated by averaging the daily measured values with the interpolated daily values between them (assuming the concentration is zero at day 60). Chronic pore water concentration values are calculated from the dry weight values based on an assumption of equal volumes of water and solids in the sediment (OPP Standard Pond) and a Kd of 2.4 for Imidacloprid. See Table 2.

Table 2. Willapa Bay Sediment Concentrations

	Sediment Concentration (mg/kg (ppm) dry weight)	Calculated Concentration (Pore Water: mg/L (ppm))
Initial (Day 0)	0.461 (measured)	0.1921 (calculated)
(Day 1)	0.0164 (measured)	0.0068 (calculated)
(Day 14)	0.00267 (measured)	0.0011 (calculated)
(Day 28)	0.00472 (measured)	0.0020 (calculated)
(21-day Average)	0.0281 (calculated)	0.0117 (calculated)
(60-day Average)	0.0118 (calculated)	0.0049 (calculated)

The second study was conducted using small plot trials during 2006 – 2008 with Imidacloprid (Admire 1.6F, Bayer Corp.; Imida 2F, Etigra) and is the one submitted with this EUP request. Imidacloprid was applied aerially using helicopters to 7 commercial shellfish beds on July 2. Experimental beds were proposed by grower collaborators and selected based on degree of shrimp infestation, size, and proximity to untreated areas or beds treated with Sevin. A 20 acre bed located near the mouth of the North River (A90) had been fallow for at 12 years, had a moderate to heavy shrimp infestation and was isolated from other shellfish beds, so provided a good site to study both efficacy and non-target impact to salmonids. A 10 acre bed near the mouth of the Cedar River (A40) was also used as a site to assess both non-target impact and efficacy. In this study, water was sampled for analysis of Imidacloprid concentration directly on the bed of three beds and in the adjacent channels of two beds. On-bed samples were taken by grab near the center of the bed, initially when depth of the in-coming tide reached six inches and on subsequent high tides at mid-depth of the water column. In-channel grab samples were taken at both maximum low and high tides at mid-depth of the water column.

Concentrations of Imidacloprid sampled over the beds dropped precipitously between 1 and 6 hours after treatment and were not detected afterward. At one hour concentrations immediately over the bed were 0.120 ppm, 0.040 ppm and 0.040 ppm at plots 90, 40 and 163 respectively.

Water concentrations in channels adjacent to two plots were recovered at 6 hours (0.000015 ppm), at 24 hours (0.00009 ppm), at 49 hours (0.00006 ppm) and at 74 hours (0.00003 ppm) after treatment (plot 90) and at 24 hours (0.0003 ppm), at 49 hours (0.00009 ppm) and at 74 hours (0.00006 ppm) after treatment (plot 40). (Method Reporting Limit = 0.00002 ppm). These timings were synchronized to the high tides.

Measured Imidacloprid concentrations in the water directly above the treated beds as the tidal flow begins are extremely variable, dissipate within 30 minutes to a few hours in both stiudies and are not useful for risk assessment. In the second study, however, there were detections in the channels adjacent to the beds for up to three days (73 hours). Average concentrations in these adjacent channels are presented in Table 3 below.

Table 3. Average Imidacloprid Water Column Concentrations in Channels Adjacent to Treated Beds (Plots)

Time After Application	Water Column Concentrations (ppm)
(Day 0: 6 hours)	0.000015 (Plot 90 Only)
(Day 1: 24 hours)	0.000195
(Day 2: 49 hours)	0.000075
(Day 3: 73 hours)	0.000045

Risks to Terrestrial organisms

No risks to terrestrial organisms are expected because the proposed uses are all in aquatic areas. No exposure should occur under the subsurface application method. Aerial application is made to exposed beds at low tide. These areas will be submerged later in the day at high tide. Any effects, if they occur at all, will likely be very much localized due to the small acreages under the current EUP and that the area will be submerged soon after application.

Acute toxicity studies with honeybees show that imidacloprid is very highly toxic to non-target insects (LD_{50} = 0.0039 - 0.078 μg/bee). This is a concern for pollinators because imidacloprid is a systemic pesticide which has been shown to translocate into the nectar and pollen of crop plants grown from treated seed. Studies with ornamental plants have shown that imidacloprid may also translocate into plant parts when the chemical is applied to the soil around the base of the plants. In these studies with ornamentals, detectable residues were found in flowers and leaves as long as 540 days after application to the soil. However, under the current application, risks to bees should be low since it is an aquatic use and not near bee habitats.

Risks to Aquatic organisms
EECs were developed from the study of imidacloprid use in Willapa bay. EFED's screening assessment suggests that exposure from this compound to an estuarine/marine system could result in acute and chronic risk to estuarine/marine invertebrates in the sediment pore water (acute RQ = 5.20; chronic RQ = 19.50). Imidocloprid is less toxic to estuarine mollusks than it is to estuarine invertebrates by several orders of magnitude. This assessment also demonstrates very low risk to the surrogate eastern oyster species (Acute RQ < 0.0013). Risks within the bay will likely be localized to the target area. Risks to freshwater fish or invertebrates were not assessed because the product will not be used in those areas.

Acute and chronic RQ's for evaluating toxic risk of imidacloprid exposure to estuarine/marine fish & invertebrates in pore water. RQ's are based on the sheepshead minnow (*Cyprinodon variegatus*) LC_{50} = 163 ppm, NOAEC = 2.3 ppm[1] and mysid shrimp (*Mysidopsis bahia*) EC_{50} = 0.037 ppm, NOAEC = 0.0006 ppm and Eastern Oyster (EC_{50} > 145 ppm).

Use	Endpoint	Surrogate	EC_{50} (ppm)	NOAEC (ppm)	EEC Peak (ppm)	EEC 21 & 60-Day Ave. (ppm)	Acute RQ (EEC/ LC_{50})	Chronic RQ (EEC/ NOAEC)
Aquatic Pore Water	Estuarine/ Marine Fish	Sheepshead Minnow	163	2.3	0.1921	0.0049	0.0012	0.0021
Aquatic Pore Water	Estuarine/ Marine invertebrate	Mysid Shrimp	0.037	0.0006	0.1921	0.0117	**5.20**	**19.50**
Aquatic Pore Water	Estuarine/ Marine invertebrate	Eastern Oyster	>145	N/A	0.1921	N/A	< 0.0013	N/A

[1] Extrapolated value using an acute/chronic ratio from freshwater fish

Imidacloprid exposure is not expected to result in direct acute and chronic toxic effects to fish. Secondary adverse effects (fish life stage development) and adverse effects at the ecosystem level both to the organisms themselves as well as producing food chain and population disruptions are also unlikely due to the limited extent of the applications within the bays. Impacts of diminished invertebrate diversity on ecosystem integrity have not been explicitly evaluated but are also believed to be minimal. The rate of invertebrate recovery and/or the impact of decreased invertebrate diversity on higher trophic levels are an uncertainty but are likely to be minimal due to the small scope of the proposed use..

Risks to Endangered Species
Endangered estuarine invertebrates living in the pore water may be adversely affected from exposure to imidacloprid under this EUP. However, there were no estuarine invertebrates listed for that area in the EFED database.

Probit Slope Analysis
The probit slope response relationship is evaluated to calculate the chance of an individual event corresponding to the listed species acute LOCs. If information is unavailable to estimate a slope for a particular study, a default slope assumption of 4.5 is used as per original Agency assumptions of typical slope cited in Urban and Cook (1986).

Aquatic Species
Acute toxicity studies for imidacloprid did provide raw data and estimates of slopes for most fish and invertebrate species. A default slope of 4.5 was used for freshwater fish. Based on this slope, the corresponding estimate chance of individual mortality following exposure is 1 in 4.17×10^{8}. Analysis of raw data from the aquatic acute toxicity studies provided slopes of 1.69 for freshwater invertebrates, 4.21 for estuarine/marine invertebrates and 6.82 for estuarine/marine fish. Based on these slopes, the corresponding estimate chance of individual mortality following imidacloprid exposure is 1 in 71.7 for freshwater invertebrates, 1 in 4.62×10^{7} for estuarine/marine invertebrates and 1 in 1×10^{16} for estuarine/marine fish.

Incident Reports
The Agency's Ecological Incident Information System (EIIS) does contain reports of damage or adverse effects to non-target organisms attributed to the use of imidacloprid. There are incidents involving imidacloprid that have been noted reflecting lawn use and effects to non-target organisms: 1) surfaced dead grubs appeared to have been eaten by birds, resulting in the death of several young and adult robins; 2) possible runoff event from a lawn resulted in the death of 3,000 crayfish in a near-by stream; 3) "mad bee" disease in France; 4 & 5) lawn grass chemically burned by the application of the compound; and 6 &7) bee kills

#I007257-001 A private citizen of Myerstown, Pa. reported watering in pesticide (GrubEx) and then found that grubs had surfaced a couple of days later. He was very concerned to see that the birds that fed on the grubs died.

#I007892-007 Turf application resulted in possible runoff into McKenna Creek (Columbus, Ohio) killing about 3,000 crawfish. Pesticide application was made on 7/22, slight rain event occurred on 7/22 (0.01 inches) and on 7/23 (0.09 inches). On July 23 dead crawfish were found. Water samples taken two days after the incident showed imidacloprid residues at 0.17, 0.11, and 1.3 ppb. In all likelihood the initial concentration was much higher. Water samples also detected metolachlor residues.

#I010775-001 Protest by the National Union of French Beekeepers have targeted GAUCHO, made by Bayer AC. This product along with REGENT TS (fipronil) was used to coat sunflower seeds for protection against insects. The French Farm Ministry suspended use of GAUCHO over the concerns about the aberrant disorientated behavior ("mad bee disease") of honey bees that had been associated with the sunflower crop that had originated from the coated seeds. Imidacloprid residues were found in the nectar.

#I009445-035 September 1999, complaint from resident in Assonet, MA. Home owner applied GrubEx Season-Long Grub Control to his lawn in June. He claims that 50% of the lawn burned.

#I009445-036 Resident in Brooklyn, NY applied GrubEx Season-Long Grub Control to his lawn and the entire lawn turned brown.

I020700-001 Bayer reported bee kill.

#I021017 August 2009, bee kills reported after application to Linden trees in Pittsburgh PA. Bee deaths ceased when trees stopped blooming.

A lack of reported incidents does not necessarily mean that such incidents have not occurred. In addition, incident reports for non-target plants and animals typically provide information on mortality events only. Reports for other adverse effects, such as reduced growth or impaired reproduction, are rarely received.

Toxicity

Measures of ecological effects and exposure for Imidacloprid.

Assessment Endpoint		*Surrogate Species and Measures of Ecological Effect*[1]	*Measures of Exposure*
Birds[2]	Survival	House sparrow acute oral LD_{50} = 41.0 mg/kg (2.5G) (MRID 420553-09) Quail acute oral LD_{50} = 152.3 mg/kg (MRID 420553-08) Mallard duck acute oral LC_{50} >4797 ppm (MRID 420553-11) Bobwhite acute dietary LC_{50} = 1536 ppm (MRID 420553-10)	Maximum residues on food items
	Reproduction and growth	Bobwhite chronic reproduction NOAEC= 36 ppm (MRID 420553-12) Mallard chronic reproduction NOAEC= 47 ppm (MRID 434665-01)	Maximum residues on food items
Mammals	Survival	Laboratory rat acute oral LD_{50} = 424 mg/kg (MRID 420553-31)	Maximum residues on food items
	Reproduction and growth	Laboratory rat oral reproduction chronic NOAEC = 250 ppm (MRID 422563-40)	Maximum residues on food items
Freshwater fish[3]	Survival	Bluegill sunfish acute LC_{50} >105 ppm (MRID 420553-14) Rainbow trout acute LC_{50} >83 ppm (MRID 420553-15)	Peak EEC[4]
	Reproduction and growth	Rainbow trout chronic (early life-stage) NOAEC=1.2 ppm and LOAEC=2.5 ppm (MRID 420553-20)	60-day average EEC[4]
Freshwater Invertebrates	Survival	Midge acute EC_{50} = 0.069 ppm (MRID 422563-04)	Peak EEC[4]
	Reproduction and growth	Water flea chronic (life cycle) NOAEC= 1.3 ppm LOAEC= 3.6 ppm (MRID 420553-21)	21-day average EEC[4]

Assessment Endpoint		*Surrogate Species and Measures of Ecological Effect*[1]	*Measures of Exposure*
Estuarine/ Marine fish	Survival	Sheepshead minnow acute LC_{50} = 163 ppm (MRID 420553-18)	Peak EEC[4]
	Reproduction and growth	(no data)	60-day average EEC[4]
Estuarine/ Marine Invertebrates	Survival	Eastern oyster acute EC_{50} >145 ppm (MRID 422563-05) Mysid shrimp acute LC_{50} = 0.037 ppm (MRID 420553-19)	Peak EEC[4]
	Reproduction and growth	Mysid chronic NOAEL > 0.0006 ppm and LOAEC = 0.0013 (MRID 420553-22)	21-day average EEC[4]
Terrestrial Plants[5]	Survival and growth	(no data)	Estimates of runoff and spray drift to non-target areas
Insects	Survival	Honeybee acute contact LD_{50}= 0.0039 ug/bee (MRID 422730-03)	Maximum application rate
Aquatic Plants and Algae	Survival	Green algae EC_{50} > 10 ppm (MRID 422563-74)	Peak EEC

[1] If species listed in this table represent most commonly encountered species from registrant-submitted studies, risk assessment guidance indicates most sensitive species tested within taxonomic group are to be used for baseline risk assessments.
[2] Birds represent surrogates for amphibians (terrestrial phase) and reptiles.
[3] Freshwater fish may be surrogates for amphibians (aquatic phase).
[4] One in 10-year return frequency.
[5] Four species of two families of monocots - one is corn, six species of at least four dicot families, of which one is soybeans. LD_{50} = Lethal dose to 50% of the test population; NOAEC = No observed adverse effect concentration; LOAEC = Lowest observed adverse effect concentration; LC_{50} = Lethal concentration to 50% of the test population; EC_{50}/EC_{25} = Effect concentration to 50%/25% of the test population.

Appendix A. Bibliography

Felsot A. S. and Rupert, J.R., 2002. Imidacloprid residues in Willapa Bay (Washington State) water and sediment following application for control of burrowing shrimp. J. Agric. Food Chem. 50: 4417-4423.

Appendix B. Environmental Fate and Transport Studies and Toxicity Studies for Imidacloprid

161-1 Hydrolysis

MRID	Citation Reference
42055337	Yoshida, H. (1989) Hydrolysis of NTN 33893: Lab Project No: 88011/ ESR: 99708. Unpublished study prepared by Nihon Tokushu Noyaku Seizo K.K. 34 p.

161-2 Photodegradation-water

MRID	Citation Reference
42256376	Anderson, C. (1991) Photodegradation of NTN 33893 in Water: Lab Project Number: 88010: 101956. Unpublished study prepared by Nitokuno, ESR, Yuki Institute. 128 p.

161-3 Photodegradation-soil

MRID	Citation Reference
42256377	Yoshida, H. (1990) Photodegradation of NTN 33893 on Soil: Lab Project Number: 88012/ESR: 100249. Unpublished study prepared by Nihon Tokushu Noyaku Siezo K. K. 42 p.

162-1 Aerobic soil metabolism

MRID	Citation Reference
42073501	Anderson, C.; Fritz, R.; Brauner, A. (1991) Metabolism of ?Pyridinyl-C 14-Methylene| NTN 33893 in Sandy Loam under Anaerobic Conditions: Lab Project Number: 101241; M1250187-4. Unpublished study prepared by Bayer Ag--Leverkusen. 82 p.
45239301	Anderson, C.; Fritz, R.; Brauner, A. (1992) Metabolism of (Pyridinyl-(carbon 14)-Methylene) NTN 33893 in Loamy Sand Soil BBA 2.2 under Aerobic Conditions: Lab Project Number: M 1250187-4. Unpublished study prepared by Miles Incorporated. 83 p.
45239302	Fritz, C. (1992) Degradation of (Pyridinyl-(carbon 14)-Methylene) NTN 33893 in Silt Soil HOEFCHEN under Aerobic Conditions: Lab Project Number: M 1250187-4. Unpublished study prepared by Bayer AG. 54 p.

162-3 Anaerobic aquatic metabolism

MRID	Citation Reference
42256378	Fritz, R.; Hellpointner, E. (1991) Degradation of Pesticides Under Anaerobic Conditions in the System Water/Sediment: Imidacloprid, NTN 33893: Lab Project Number: 1520205-5: 101346. Unpublished study prepared by Bayer AG, Leverkusen-Bayerwerk. 69 p.

163-1 Leaching /adsorption /desorption

MRID	Citation Reference
42055338	Fritz, R. (1988) Adsorption/Desorption of NTN 33893 on Soils: Lab Project

	Number: M 1310231/1: 99199. Unpublished study prepared by Bayer Ag. 50 p.
42055339	Fritz, R.; Brauner, ?. (1988) Leaching Behavior of NTN 33893 Aged in Soil: Lab Project Number: M 1210225/3: 99635. Unpublished study prepared by Bayer Ag. 45 p.
42520801	Williams, M.; Berghaus, L.; Dyer, D. (1992) Soil/Sediment Adsorption-desorption of (carbon 14)-Imidacloprid: Lab Project Number: N3182101. Unpublished study prepared by ABC Labs, Inc. 70 p.
42520802	Williams, M.; Berghaus, L.; Dyer, D. (1992) Soil/Sediment Adsorption-desorption of (carbon 14)-NTN-33823: Lab Project Number: N3182102. Unpublished study prepared by ABC Labs, Inc. 63 p.
43142501	Hellpointner, E. (1994) Degradation and Translocation of Imidacloprid (NTN 33893) under Field Conditions on a Lysimeter: Lab Project Number: ME/6/95: M/1330351/6: 106426. Unpublished study prepared by Bayer AG, Institute for Metabolism Research. 74 p.
43315201	Hellpointner, E. (1994) Degradation and Translocation of Imidacloprid (NTN 33893) under Field Conditions on a Lysimeter: Amendment to the Original Report: Project Nos. M 1330351-6; 106426-1. Unpublished study prepared by Bayer AG. 12 p.

164-1 Terrestrial field dissipation

MRID	Citation Reference
42256379	Rice, F.; Judy, D.; Koch, D.; et al. (1991) Terrestrial Field Dissipation for NTN 33893 in Georgia Soil: Lab Project Number: N3022101: 101987. Unpublished study prepared by ABC Laboratories, Inc. 422 p.
42256380	Rice, F.; Judy, D.; Koch, D.; et al. (1991) Terrestrial Field Dissipation for NTN 33893 in Minnesota Soil: Lab Project Number: N3022103: 101988. Unpublished study prepared by ABC Laboratories, Inc. 510 p.
42256381	Rice, F.; Judy, D.; Koch, D.; et al. (1991) Terrestrial Field Dissipation for NTN 33893 in California Soil: Lab Project Number: N3022102: 101989. Unpublished study prepared by ABC Laboratories, Inc. 561 p.
42256382	Rice, F.; Schwab, D.; Noland, P.; et al. (1992) Terrestrial Field Dissipation in Turf for NTN 33893 in Georgia Soil: Lab Project Number: 393553: 102603. Unpublished study prepared by ABC Laboratories, Inc., and Miles Inc. 353 p.
42256383	Rice, F.; Judy, D.; Noland, P.; et al. (1992) Terrestrial Field Dissipation in Turf for NTN 33893 in Minnesota: Lab Project Number: 393543: 102604. Unpublished study prepared by ABC Laboratories, Inc., and Agri-Growth Research, Inc. 409 p.
42256384	Noland, P.; Koch, A. (1991) Analytical Method for the Determination of NTN 33893 in Soil Samples: Lab Project Number: 39272-2: 101984. Unpublished study prepared by ABC Laboratories, Inc. 82 p.
42256385	Noland, P.; Koch, A. (1991) Analytical Method for the Determination of NTN 33893 in Turf Samples: Lab Project Number: 39354-2: 101981. Unpublished study prepared by ABC Laboratories, Inc. 64 p.
42734101	Bachlechner, G. (1992) Dissipation of Imidacloprid in Soil Under Field Conditions: Lab Project Number: RA-2082/91: 103948. Unpublished study prepared by Miles Inc. 89 p.
44631501	Noland, P. (1996) NTN 33893 Freezer Storage Stability Study in Soil and Turf: Lab Project Number: 107369: N3022301: N3022303. Unpublished study prepared by Bayer Corporation: ABC Laboratories, Inc. 86 p.

166-1 Ground water-small prospective

MRID	Citation Reference
44790102	Dyer, D. (1999) Progress Report #5 and Study Termination Request: Imidacloprid (ADMIRE)--Small-Scale Prospective Ground-Water Monitoring Study, Montcalm County, Michigan, 1996: Lab Project Number: 5635.00: N3212401: N3212401-PR5. Unpublished study prepared by Bayer Corporation and Levine. Fricke.Recon, Inc. 92 p.
44790103	Dyer, D. (1999) Progress Report #4 and Study Termination Request: Imidacloprid (ADMIRE)--Small-Scale Prospective Ground-Water Monitoring Study, Montcalm County, Michigan, 1996: Lab Project Number: N3212401: N3212401-PR4: 5635.00. Unpublished study prepared by Bayer Corporation and Levine.Fricke.Recon, Inc. 307 p.
45094701	Dyer, D.; Helfrich, K. (1999) Progress Report #6: Imidacloprid (Admire)--Small-Scale Prospective Ground-Water Monitoring Study Montclam County, Michigan, 1996: Lab Project Number: N3212401: 5635.00: 109383. Unpublished study prepared by Bayer Corp. and LFR Levine. Fricke, Inc. 87 p.
45094702	Dyer, D.; Helfrich, K. (2000) Progress Report #7: Imidacloprid (Admire)--Small-Scale Prospective Ground-Water Monitoring Study Montclam County, Michigan, 1996: Lab Project Number: N3212401: 5635.00: 109596. Unpublished study prepared by Bayer Corp. and LFR Levine. Fricke, Inc. 80 p.
45094703	Lenz, M.; Helfrich, K. (2000) Imidacloprid (Admire)--Prospective Ground-Water Monitoring Study, California, Broccoli--Progress Report #12: Lab Project Number: 108939: H5034: N3212402. Unpublished study prepared by Bayer Corp. and LFR Levine. Fricke, Inc. 55 p.
45858201	Dyer, D.; Helfrich, K.; Billesbach, K. (2002) Imidacloprid--Small-Scale Prospective Ground-Water Monitoring Study, Montcalm County, Michigan, 1996: Lab Project Number: N3212401: 5635.00: CMXX-95-0229. Unpublished study prepared by Bayer Corporation, LFR Levine-Fricke, and Braun Intertec Corporation. 504 p.
45878701	Lenz, M.; Jackson, S.; Billesbach, K. (2002) Imidacloprid Prospective Groundwater Monitoring Study: Monterey County, California: Lab Project Number: N3212402: H5034: 110889. Unpublished study prepared by Bayer Corporation and Weber, Hayes & Associates. 813 p.

Ecological Studies for Imidacloprid:

71-1 Avian Single Dose Oral Toxicity

MRID	Citation Reference
42055308	Toll, P. (1990) Technical NTN 33893: An Acute Oral LD50 with Bob- white Quail: Lab Project Number: N3711702: 100059. Unpublished study prepared by Mobay Corp. 25 p.
42055309	Stafford, T. (1991) NTN 33893 2. 5G: An Acute Oral LD50 with House Sparrows (Passer domesticus): Lab Project No: N3711402: 101324. Unpublished study prepared by Mobay Corp. 23 p.
44059401	Hancock, G. (1996) NTN 33893 Technical: An Acute Oral LD50 with Mallards: (Final Report): Lab Project Number: 107354: N3710802. Unpublished study prepared by Bayer Corp. 32 p.

44457401	Schmuck, R. (1997) Acute Oral LD50 of Confidor WG 70 to Japanese Quail: (Final Report): Lab Project Number: 107904: E 293 1017-3: SXR/VW 178. Unpublished study prepared by Bayer AG Crop Protection. 35 p.

71-2 Avian Dietary Toxicity

MRID	Citation Reference
42055310	Toll, P. (1990) Technical NTN 33893: Subacute Dietary LC50 with Bobwhite Quail: Lab Project Number: N3721702: 100241. Unpublished study prepared by Mobay Corp. 39 p.
42055311	Toll, P. (1991) Technical NTN 33893: A Subacute Dietary LC50 with Mallard Ducks: Lab Project Number: N3720801: 100238. Unpublished study prepared by Mobay Corp. 36 p.

71-4 Avian Reproduction

MRID	Citation Reference
42055312	Toll, P. (1991) Technical NTN 33893: A One Generation Reproduction Study with Bobwhite Quail: Lab Project Number: N3741701: 1011203 . Unpublished study prepared by Mobay Corp. 114 p.
42055313	Toll, P. (1991) Technical NTN 33893: A One Generation Reproduction Study with Mallard Ducks: Lab Project Number: N3740801: 101205. Unpublished study prepared by Mobay Corp. 105 p.
42480502	Stafford, T. (1992) Technical NTN 33893: A One Generation Reproduction Study with Mallard Ducks: Lab Project Number: N3740802: 103813. Unpublished study prepared by Miles, Inc. 99 p.
43466501	Hancock, G. (1994) Effect of Technical NTN 33893 on Eggshell Quality in Mallards: Lab Project Number: N3740804: 106623. Unpublished study prepared by Miles Inc. 84 p.

71-5 Simulated or Actual Field Testing

MRID	Citation Reference
42737101	Toll, P.; Fischer, D. (1993) Merit 0.62% Granular Insecticide: An Evaluation of Its Effects Upon Birds at Golf Courses in the Columbus, Ohio Vicinity: Lab Project Number: N3752302: 105002. Unpublished study prepared by Miles, Inc. 824 p.

72-1 Acute Toxicity to Freshwater Fish

MRID	Citation Reference
42055314	Bowman, J.; Bucksath, J. (1990) Acute Toxicity of NTN 33893 To Blue gill (Lepomis macrochirus): Lab Project Number: 37860: 100348. Unpublished study prepared by Analytical Bio-chemistry Labs., Inc. 29 p.
42055315	Bowman, J.; Bucksath, J. (1990) Acute Toxicity of NTN 33893 to Rain bow Trout (Oncorhynchus mykiss): Lab Project Number: 37861: 100349. Unpublished study prepared by Analytical Bio-Chemistry Labs., Inc. 31 p.
42055316	Grau, R. (1988) The Acute Toxicity of NTN 33893 Technical to Rain- bow Trout (Salmo gairdneri) in a Static Test: Lab Project No: E 2800098-7: 101303. Unpublished study prepared by Bayer Ag. 18 p.

72-2 Acute Toxicity to Freshwater Invertebrates

MRID	Citation Reference
42055317	Young, B.; Hicks, S. (1990) Acute Toxicity of NTN 33893 To Daphnia magna: Lab Project Number: 37862: 10245. Unpublished study pre- pared by Analytical Bio-Chemistry Labs., Inc. 30 p.
42256303	England, D.; Bucksath, J. (1991) Acute Toxicity of NTN 33893 to Hyalella azteca: Lab Project Number: 39442: 101960. Unpublished study prepared by ABC Labs., Inc. 29 p.
43946601	Roney, D.; Bowers, L. (1996) Acute Toxicity of (carbon 14)-NTN 33823 to Hyalella azteca Under Static Conditions: Lab Project Number: 107315: N3823202. Unpublished study prepared by Bayer Corp. 34 p.
43946602	Bowers, L. (1996) Acute Toxicity of (carbon 14)-NTN 33823 to Chironomus tentans Under Static Conditions: Lab Project Number: 107316: N3823302. Unpublished study prepared by Bayer Corp. 30 p.
43946603	Dobbs, M.; Frank, J. (1996) Acute Toxicity of (carbon 14)-NTN 33519 to Hyalella azteca Under Static Conditions: Lab Project Number: 107148: N3823201. Unpublished study prepared by Bayer Corp. 31 p.
43946604	Dobbs, M.; Frank, J. (1996) Acute Toxicity of (carbon 14)-NTN 33519 to Chironomus tentans Under Static Conditions: Lab Project Number: 107311: N3823301. Unpublished study prepared by Bayer Corp. 35 p.
44558901	Bowers, L.; Lam, C. (1998) Acute Toxicity of 6-chloronicotinic acid (a metabolite of Imidacloprid) to Chironomus tentans Under Static Renewal Conditions: Lab Project Number: 96-B-123: 108127. Unpublished study prepared by Bayer Corporation. 24 p.

72-3 Acute Toxicity to Estuarine/Marine Organisms

MRID	Citation Reference
42055318	Ward, G. (1990) NTN-33893 Technical: Acute Toxicity to Sheepshead Minnow, Cyprinodon variegatus, Under Static Test Conditions: Lab Project Number: J9008023E: 100354. Unpublished study prepared by Toxikon Environmental Sciences. 36 p.
42055319	Ward, S. (1990) NTN-33893 Technical: Acute Toxicity to the Mysid, Mysidopsis bahia, Under Flow-Through Test Conditions: Lab Project Number: J9008023B/F: 100355. Unpublished study prepared by Toxikon Environmental Sciences. 46 p.
42256305	Wheat, J.; Ward, S. (1991) NTN 33893 Technical: Acute Effect on New Shell Growth of the Eastern Oyster, Crassostrea virginica: Lab Project Number: J9008023D: J9107005. Unpublished study prepared by Toxikon Environmental Sciences. 54 p.
42528301	Lintott, D. (1992) NTN 33893 (240 FS Formulation): Acute Toxicity to the Mysid, Mysidopsis bahia under Flow-through Conditions: Lab Project Number: J9202001: 103845. Unpublished study prepared by Toxikon Environmental Sciences. 43 p.

72-4 Fish Early Life Stage/Aquatic Invertebrate Life Cycle Study

MRID	Citation Reference
42055320	Cohle, P.; Bucksath, J. (1991) Early Life Stage Toxicity of NTN 33893

	Technical to Rainbow Trout (Oncorhynchus mykiss) in a Flow-through System: Lab Project Number: 38347: 101214. Unpublished study prepared by Analytical Bio-Chemistry Labs., Inc. 8 p.
42055321	Young, B.; Blake, G. (1990) 21-Day Chronic Static Renewal Toxicity of NTN 33893 To Daphnia magna: Lab Project No: 38346: 100247. Unpublished study prepared by Analytical Bio-Chemistry Labs., Inc. 84 p.
42055322	Ward, G. (1991) NTN 33893 Technical: Chronic Toxicity to the Mysid, Mysidopsis bahia, Under Flow-Through Test Conditions: Lab Pro- ject Number: J9008023G/H: 101347. Unpublished study prepared by Toxikon Environmental Sciences. 87 p.
42256304	Gagliano, G. (1991) Growth and Survival of the Midge (Chironomus tentans) Exposed to NTN 33893 Technical Under Static Renewal Conditions: Lab Project Number: N3881401: 101985. Unpublished study prepared by Mobay Corp. 43 p.
42480501	Gagliano, G. (1992) Raw Data and Statistical Analysis Supplement for Early Life Stage Toxicity of NTN 33893 to Rainbow Trout (Oncorhynchus mykiss): Lab Project Number: 38347. Unpublished study prepared by ABC Labs, Inc. 292 p.

141-1 Honey bee acute contact

MRID	Citation Reference
42273003	Cole, J. (1990) The Acute Oral and Contact Toxicity to Honey Bees of Compound NTN 33893 Technical: Lab Project Number: 101321. Unpublished study prepared by RCC, Research and Consulting Company AG. 13 p.
42480503	Mayer, D.; Lunden, J.; Husfloen, M. (1991) Integrated Pest and Pollinator Investigations 1991 (Including Honey Bee Toxicity of NTN 33893): Lab Project Number: 103815. Unpublished study prepared by Miles, Inc. 13 p.

141-2 Honey bee residue on foliage

MRID	Citation Reference
42480503	Mayer, D.; Lunden, J.; Husfloen, M. (1991) Integrated Pest and Pollinator Investigations 1991 (Including Honey Bee Toxicity of NTN 33893): Lab Project Number: 103815. Unpublished study prepared by Miles, Inc. 13 p.
42632901	Hancock, G.; Fischer, D.; Mayer, D.; et al. (1992) NTN 33893: Toxicity to Honey Bees on Alfalfa Treated Foliage: Lab Project Number: N3772902: 103938. Unpublished study prepared by Washington State University and Miles Residue Analysis Lab. 62 p.

122-2 Aquatic plant growth

MRID	Citation Reference
42256374	Heimbach, F. (1989) Growth Inhibition of Green Algae (Scenedesmus suspicatus) Caused by NTN 33893 (Technical): Lab Project Number: 100098. Unpublished study prepared by Bayer Ag. 17 p.

123-2 Aquatic plant growth

MRID	Citation Reference
42256375	Gagliano, G.; Bowers, L. (1991) Acute Toxicity of NTN 33893 Technical to the Green Algae (Selenastrum capricornutum): Lab Project Number: N3881601:

101986. Unpublished study prepared by Mobay Corp. 30 p.
44187101 Bowers, L. (1996) Toxicity of NTN 33893 2F to the Blue-Green Alga Anabaena flos-aquae: (Final Report): Lab Project Number: 107549: N3831401. Unpublished study prepared by Bayer Corp. 31 p.
44187102 Hall, A. (1996) Toxicity of NTN 33893 2F to the Freshwater Diatom Navicula pelliculosa: (Final Report): Lab Project Number: 107658: N3883401. Unpublished study prepared by Bayer Corp. 31 p.

Non-Guideline Studies

47303401 Doering, J.; Maus, C.; Anderson, C. (2004) Residues of Imidacloprid WG 5 in Blossom Samples of Rhododendron sp. (Variety Nova Zembla) after Soil Treatment in the Field - 2003. Project Number: G201796. Unpublished study prepared by Bayer CropScience Ag. 15 p.
47303402 Doering, J.; Maus, C.; Schoening, R. (2005) Residues of Imidacloprid WG 5 in Blossom and Leaf Samples of Amelanchier sp. after Soil Treatment in the Field - Application: 2003, Sampling: 2004 and 2005. Project Number: G201799, P672034512, AMELANCHIER/NTN33893WG5/DRENCH/NON/GLP. Unpublished study prepared by Bayer Ag, Institute of Product Info. & Residue Anal. and Bayer CropScience. 17 p.
47303403 Doering, J.; Maus, C.; Schoening, R. (2005) Residues of Imidacloprid WG 5 in Blossom Samples of Cornus mas after Soil Treatment in the Field - Application: 2003, Sampling: 2005. Project Number: G201801, P672034512, CORNUS/NTN33893WG5/DRENCH/NON/GLP. Unpublished study prepared by Bayer Ag, Institute of Product Info. & Residue Anal. and Bayer CropScience. 13 p.
47303404 Doering, J.; Maus, C.; Schoening, R. (2004) Residues of Imidacloprid WG 5 in Blossom Samples of Rhododendron sp. (Variety Nova Zembla) after Soil Treatment in the Field - Application: Spring 2003, Sampling 2003 and 2004. Project Number: G201806. Unpublished study prepared by Bayer CropScience and Bayer Ag, Institute of Product Info. & Residue Anal. 20 p.
47303405 Maus, C.; Schoening, R.; Doering, J. (2006) Assessment of Effects of Imidacloprid WG 70 on Foraging Activity and Mortality of Honey Bees and Bumblebees after Drenching Application under Field Conditions on Shrubs of the Species Rhododendron catabiense grandiflorum Surrounded by other. Project Number: G201808, P672054701, RHODO/MONITORING/FIELD/2005. Unpublished study prepared by Bayer Ag, Institute of Product Info. & Residue Anal. and Bayer CropScience. 25 p.
47303406 Maus, C.; Schoening, R.; Doering, J. (2007) Assessment of Effects of a Drench Application of Imidacloprid WG 70 to Shrubs of Rhododendron sp. and to Hibiscus syriacus on Foraging Activity and Mortality of Honeybees and Bumblebees Under Field Conditions. Project Number: FEILD/MONITORING/2006/RHODO/HIBI, P672064704, G201809. Unpublished study prepared by Bayer Ag, Institute of Product Info. & Residue Anal. and Bayer CropScience. 45 p.
47303407 Maus, C.; Schoening, R.; Doering, J. (2005) Assessment of Imidacloprid WG 5 in Blossom Samples of Shrubs of Different Sizes of the Species Rhododendron sp. after Drenching Application in the Field - Application 2004, Sampling 2005. Project Number: P672044712, G201813, RHODO05/NTN33893WG5/DRENCH/NON/GLP. Unpublished study prepared by Bayer Ag, Institute of Product Info. & Residue Anal. and Bayer CropScience. 18 p.
47303408 Doering, J.; Anderson, C.; Maus, C. (2004) Determination of the Residue Levels of Imidacloprid and Its Metabolites Hydroxy-Imidacloprid and Olefin-Imidacloprid in

Leaves and Blossoms of Horse Chestnut Trees (Aesculus hippocastanum) After Soil Treatment - Application 2001 and Sampling 2002. Project Number: G201815. Unpublished study prepared by Bayer CropScience. 17 p.

47303409 Doering, J.; Anderson, C.; Maus, C. (2004) Determination of the Residue Levels of Imidacloprid and Its Metabolites Hydroxy-Imidacloprid and Olefin-Imidacloprid in Leaves and Blossoms of Horse Chestnut Trees (Aesculus hippocastanum) After Trunk Injection - Application 2001 and Sampling 2002. Project Number: G201817, P/672024504, MR/183/03. Unpublished study prepared by Bayer CropScience. 17 p.

47303410 Doering, J.; Maus, C.; Schoening, R. (2004) Residues of Imidacloprid WG 5 in Blossom Samples of Lime Trees (Tilia europaea) After Soil Treatment in the Field - Application: 2003, Sampling: 2004. Project Number: G201818, P672034513, TILIA/NTN33893WG5/DRENCH/NON/GLP. Unpublished study prepared by Bayer Ag, Institute of Product Info. & Residue Anal. and Bayer CropScience. 14 p.

47303411 Doering, J.; Maus, C.; Schoening, R. (2004) Residues of Imidacloprid WG 5 in Blossom and Leaf Samples of Apple Trees After Soil Treatment in the Field - Application: 2003, Sampling: 2004. Project Number: G201819, P672034511, MALUS/NTN33893WG5/DRENCH/NON/GLP. Unpublished study prepared by Bayer Ag, Institute of Product Info. & Residue Anal. and Bayer CropScience. 15 p.

47303412 Doering, J.; Maus, C.; Schoening, R. (2004) Residues of Imidacloprid WG 5 in Blossom Samples of Rhododendron sp. After Soil Treatment in the Field - Application: Autumn 2003, Sampling: 2004. Project Number: G201820, P672034514, RHODO/NTN33893WG5/DRENCH/NON/GLP. Unpublished study prepared by Bayer Ag, Institute of Product Info. & Residue Anal. and Bayer CropScience. 14 p.

47303413 Maus, C.; Anderson, C.; Doering, J. (2004) Determination of the Residue Levels of Imidacloprid and Its Relevant Metabolites in Nectar, Pollen and Other Plant Material of Horse Chestnut Trees (Aesculus hippocastanum) After Soil Treatment Application and Sampling 2001. Project Number: MAUS/AM021, E/370/2009/1. Unpublished study prepared by Bayer CropScience Ag. 23 p.

47303414 Maus, C.; Anderson, C.; Doering, J. (2004) Determination of the Residue Levels of Imidacloprid and Its Relevant Metabolites in Nectar, Pollen and Other Plant Material of Horse Chestnut Trees (Aesculus hippocastanum) After Trunk Injection Application and Sampling 2001. Project Number: MAUS/AM023, E/370/2057/4. Unpublished study prepared by Bayer CropScience. 27 p.

The following studies are in review:

47523401 Bonmatin, J.; Moineau, I.; Charvet, R.; et al. (2005) Behaviour of Imidacloprid in Fields. Toxicity for Honey Bees. P. 483-494 in Environmental Chemistry and Pollutants in Ecosystems by Lichtfouse, E., Schwartz-Bauer, J. and Robert, D. New York, NY: Springer

47523402 Suchail, S.; Guez, D.; Belzunces, L. (2001) Discrepancy Between Acute and Chronic Toxicity Induced by Imidacloprid and its Metabolites in Apis mellifera. Environmental Toxicology and Chemistry 20 (11) : 2482-2486.

47523403 Chauzat, M.; Faucon, J.; Martel, A.; et al. (2005) A Survey of Pesticide Residues in Pollen Loads Collected by Honey Bees In France. Entomological Society of America 99(2): 253-262.

47523404 Iwasa, T.; Motoyama, N.; Ambrose, J.; et al. (2003) Mechanism for the Differential Toxicity of Neonicotinoid Insecticides in the Honey Bee, Apis mellifera. Crop Protection 23(2004): 371-378.

47523405 Decourtye, A.; Armengaud, C.; Renou, M.; et al. (2003) Imidacloprid Impairs Memory and Brain Metabolism in the Honeybee (Apis mellifer L.). Pesticide Biochemistry and Physiology 78: 83-92.

47523406 Faucon, J.; Aurieres, C.; Drajnudel, P.; et al. (2005) Experimental Study on the Toxicity of Imidacloprid Given in Syrup to Honeybee (Apis mellifer) Colonies. Pest Management Science 61: 111-125.

47523407 Westwood, F.; Bean, K.; Dewar, A.; et al. (1998) Movement and Persistence of [Carbon 14] Imidacloprid in Sugar-Beet Plants Following Application to Pelleted Sugar-Beet Seed. Pestic. Sci. (52): 97-103.
47523408 Colin, M.; Bonmatin, J.; Moineau, I.; et al. (2004) A Method to Quantify and Analyze the Foraging Activity of Honey Bees: Relevance to the Sublethal Effects Induced by Systemic Insecticides. Archives of Environmental Contamination and Toxicology 47: 387-395.
47523409 Suchail, S.; Debrauwer, L.; Belzunces, L. (2003) Metabolism of Imidacloprid in Apis mellifera. Pest Management Science 60: 291-296.
47523410 Decourtyle, A.; Lacassie, E.; Phan-Delegue, M. (2003) Learning Performances on Honeybees (Apis mellifera L) are Differentially Affected by Imidacloprid According to the Season. Pest Management Science 59: 269-278.
47523411 Bonmatin, J.; Marchand, P.; Charvet, R.; et al. (2005) Quantification of Imidacloprid Uptake in Maize Crops. Journal of Agricultural and Food Chemistry 53: 5336-5341.